

After an Immersive Learning Project: Turning Data into Clinical Practice

An Honors Thesis (HONR 499)

by

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Thesis Advisor

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Abstract

The treatment of neonatal dysphagia patients is hindered by the variability of dysphagia treatment. The use of various formulas, thickeners and liquid viscosities used during swallowing therapy perpetuate an uncontrolled clinical environment. During experiments conducted in an Immersive Learning course at Ball State University, students used viscometers and the IDDSI drip test to analyze the viscosities of several commonly used recipes designed to thicken infant formulas. Measurements were compared to Varibar Barium to determine the correlation with prescribed thickened liquids. I organized and analyzed the collected data to draw conclusions regarding clinical application and continued research in this area.

Acknowledgements

I would like to thank Mrs. Mary Ewing and Dr. Ranjith Wijesinghe for their constant support throughout the duration of this project. Their guidance was invaluable during this process. I would like to express my gratitude toward the community partners St. Vincent Health System, Molly Jones, M.A. CCC-SLP, BCS-S and IU Health, Catherine Seitz, M.A. CCC-SLP for their willingness to contribute their time and resources. Finally, I would like to recognize my loving family for encouraging to persevere through the journey that has been my undergraduate experience.

Process Analysis

To conduct my research, I began by reading medical journals, American Speech and Hearing Association journals related to infant dysphagia treatment. I read about studies similar to the research being conducted throughout the Ball State University Immersive Learning course *Analysis of Fluid Viscosities Used to Treat Human Dysphagia*. I noticed that other research teams were drawing conclusions using data comparable to the data we collected. I felt I needed a more in depth understanding of the incredible amount of data collected through Ball State University student efforts. I sought to create an organizational system to contain all data related to infant and neonatal dysphagia treatment obtained during the Ball State University Immersive Learning course. (Appendices item 1) I went page by page through thousands of data reports and tagged and transcribed data pertinent to my study in a spread sheet. Ball State students have conducted research on dysphagia treatment throughout the lifespan, so I narrowed my focus to infant and neonatal related treatment materials. The creation of this comprehensive list allowed me to sort data and analyze different variables. From the comprehensive list I selected a data set to analyze further.

The data set I selected considered several popular infant formulas and breastmilk. I utilized both powder and ready to use formula data to see if there is any noticeable difference between the two types. I included breastmilk because in clinical practice it is common to encounter families which have strong feelings about using breastmilk to nourish their children. I ran additional viscometer tests with breastmilk samples to get a complete data set with uniform comparison points. When selecting liquid thickeners, I chose to focus on thickener recipes utilized by the Immersive Learning project's community partners to see if there is any variation between current clinical practice and viscosity measurements. These recipes call for a designated

ratio of infant formula combined with Gerber Oatmeal Cereal. Gerber Oatmeal Cereal is commonly used for infant dysphagia treatment because it is considered normal practice to use with this population. I used commercial products Simply Thick and Thick & Clear to provide comparative data. Neither of the commercial products are commonly used in treating infant dysphagia because of age related patient concerns. Simply Thick is not recommended for clinical usage for individuals under the age of twelve; Thick & Clear does not provide an age recommendation.

Next, I began creating Figures to visually represent the selected data sets. I chose to incorporate Varibar Barium, nectar thick, on the figures as another comparative point. This allows viewers to compare dysphagia diagnostic material with selected treatment material in the same figure. After creating uniformly formatted figures I analyzed the presented data on whether the recipe fell within the desired National Dysphagia Diet limit, 51-350 cP. I looked at the samples' reactivity over the course of the twenty-three-minute viscometer test and made note of changes or patterns of fluid viscosity. I assessed whether the viscometer measurements were consistent with the International Dysphagia Diet Standardization Initiative drip test. From all of these assessments I concluded which thickening agents were most and least affective and any notable discrepancies. I had hoped to discern improved clinical practice recommendations. Instead my findings showed great need for further research and collaboration between professional communities to confer and conceive improved clinical practice standards.

I had the opportunity to present my findings at the Indiana Speech and Hearing Association Conference (ISHA) in early April. I summarized my report and presented the figures on a poster presentation. (Appendices item 2) At ISHA I presented and discussed my results with professionals and student researchers from a multitude of professional and academic

backgrounds. The findings I presented were shocking to some and consistent with what others are experiencing in their practice. The overarching theme of many of my conversations was, “What do we do now?” My answer then and my answer now is that we are seeing concrete evidence that shows our clinical practice is not sufficient we must take further action. Many clinicians and students lack the background knowledge of the chemical properties of the infant liquids and the thickeners used to alter them. We must use interprofessional education and research opportunities to stress the importance of further research into dysphagia treatment.

A challenge I faced during my writing process is choosing what type of rhetoric would be most effective to convey the need for further research into clinical treatment of dysphagia. Earlier drafts of my writing went into greater detail explaining terminology, methods, and comparable studies in the hopes of making this study more accessible to any reader. Through my revision process, I chose to edit my writing to resemble the language and writing patterns consistent with journals published for the use of the American Speech and Hearing Association. One of the most impactful pieces of advice I received at the conferences I attended was the need to publish data and analysis which will help advocate for innovation within the field of dysphagia treatment. I was also advised to be protective of my intellectual property, but to collaborate as much as I can with other professionals and researchers to continue my advocacy. I was concerned that my thesis would be ‘too short’ or ‘not enough.’ I chose to maintain the intentionality of my research and present my findings in a ‘too the point’ fashion which, hopefully, has the greatest impact on readers.

My greatest challenge throughout this process was battling feelings of inadequacy. From drawing conclusions, to discussing my findings I was left with so many questions I was unable to answer. As a future Speech Language Pathologist I want to provide the highest quality of care to

my patients. These findings show that we are failing to provide that highest quality of care but lack the means to create a better solution. I have found solace in the fact that publishing these findings will create avenues to advocate for future research and involving nutritionists to examine the nutritional value of thickened diets, physicists and chemists to help discern the properties of thickened liquids which affect the viscosity of thickened substances and bioengineers to help create new and improved thickening agents and recipes which are consistent with diagnostic material. We now know better; it is time to do better.

Written Thesis

Introduction:

Dysphagia, or difficulty swallowing, is a medical complication seen in patients across the life span. Dysphagia can have a huge impact on the pediatric population if they are not feeding well, they could become malnourished. Dodrill & Gosa (2015) stress that infancy and childhood are periods of essential growth and development; proper nutrition is crucial to support linear and neurological growth. According to the American Speech and Hearing Association website: it is assumed that the incidence of feeding and swallowing disorders is increasing because of the improved survival rates of children with complex and medically fragile conditions (Lefton-Greif, 2008; Lefton-Greif, Carroll, & Loughlin, 2006; Newman, Keckley, Petersen, & Hamner, 2001)

Dysphagia is caused or related to complex medical conditions, developmental disabilities, neuromuscular abnormalities, genetic syndromes, neurological disorders, sensory issues, structural abnormalities and more. While treatment of infant dysphagia is a multidisciplinary effort Speech Language Pathologists are considered the rehabilitative experts in dysphagia treatment. It is known that Speech Language Pathologists in different facilities across the nation use a variety of thickening agents and recipes as therapeutic measures for infants diagnosed with dysphagia. (Mills, 2008) Limited research has been completed in this area. Undergraduate and Graduate level students have participated in an Immersive Learning Course PHYC 469/685 at Ball State University to determine the viscosity levels of liquids commonly consumed by patients diagnosed with dysphagia. Viscosity is defined as the thickness or consistency of a liquid as measured by the substance's internal friction. (Frazier, Chestnur, Jackson, Barbon, Steele, Pickler, 2016) This interdisciplinary course that is student driven, requires students to

work in small groups while communicating with the community partners to solve a problem related to the clinical world. Students gathered information from the community partners (St. Vincent Health System, Molly Jones, M.A. CCC-SLP and IU Health, Catherine Seitz, M.A. CCC-SLP, BCS-S) at the beginning of the course to determine possible liquids and thickeners to be tested. Thickeners tested include commonly reported food products in the pediatric population such as infant oatmeal cereal as well as commercially available thickeners used with pediatric patients diagnosed with dysphagia. Results were then compared to the viscosity of Varibar Barium, a common contrast diagnostic material utilized during instrumental evaluation, in order to determine prescribed appropriate liquid level. (Fink, Ross, 2009)

Viscosity was tested to determine the thickness, measured in centipoise (cP), of each thickening agent mixed with a variety of infant formulas commonly consumed. (Garcia, Changers, Matta, Clark, 2007) The values were then compared to Varibar Barium, the National Dysphagia Diet levels (NDDL) and the International Dysphagia Diet Standardization Initiative (IDDSI) levels to determine which thickening agent resulted in the desired viscosity levels. (Cichero, Lam, Steele, Hanson, Chen, Dantas, Stanschus, 2017) The main goal was to determine if the assumed viscosity of prescribed thickened liquids was actually within desired levels and hopefully make recommendations for updated clinical practice. This topic is of high concern because of its impact on the safety and well-being of patients with dysphagia. As the incidence and prevalence of dysphagia patients continues to increase, the necessity to provide the highest quality care becomes even more crucial.

Methods:

Two Brookfield DV2T Viscometers and one Brookfield DV3T Viscometer were used to collect the viscosity levels. The same samples were then measured using the IDDSI drip test. The liquids selected to present include: Gerber Gentle Ready to use (RTU), Gerber Gentle Powder formula, Enfamil Infant Ready to use (RTU) formula, Enfamil Infant Powder formula, Similac Advanced Ready to use (RTU), and Similac Advanced powder formula and breastmilk. Baseline data was collected for all liquids tested prior to mixing with chosen thickener. A standardized process for preparing infant powdered formula consisted of adding the formula to the room temperature water according to the packaged instructions and shaking for twenty seconds in a blender bottle. The process for thickening with infant oatmeal cereal, involved mixing prepared formula as described above with recipes utilized by community partners. The recipes called for fifteen cubic centimeters (cc) of infant oatmeal cereal per two ounces of liquid. Each mixture was shaken for twenty seconds in a blender bottle. The thickened liquid was poured into a beaker and tested using a Brookfield DV2T Viscometer. For Simply Thick and Thik & Clear thickeners, the sixteen ounces of formula was separated into two beakers with eight ounces in each beaker to accommodate the sample size. Simply Thick and Thik & Clear tests were mixed, according to packaging with each eight ounces of liquid. (Patole, Muller, 2005) Each mixture was stirred for twenty seconds then combined into one sixteen-ounce beaker. The mixture then sat for five minutes, was stirred for twenty seconds to ensure the sample was well blended and then tested using a Brookfield DV2T Viscometer. All thickened liquids were tested using multipoint averaging of two minutes and fifteen second intervals for a total of twenty-three minutes. The data was recorded on a spreadsheet and displayed in graphs. The viscosity of Varibar Barium thin and nectar were tested using a small sample adapter and Enhanced UL Adapter on the

Brookfield DV3T Viscometer as a baseline to compare the thickened liquid samples. All samples were tested after the five-minute wait time utilizing the International Dysphagia Diet Standardization Initiative (IDDSI) drip test prior to viscometer testing.

Results:

Figures one through four represent viscosity levels of various formulas mixed with a variety of thickeners utilized for neonatal and infant populations for the treatment of dysphagia. The blue shaded area on each figure represents the nectar thick range (51 cP to 350 cP) according to the National Dysphagia Diet Liquid (NDDL) levels. Each set of data was also compared to the International Dysphagia Diet Standardization Initiative (IDDSI) ten second flow test; with a target of 4-8 mL of the liquid tested remaining in the syringe, corresponding to a Level 2 thickness (mildly thick) as seen in figure five.

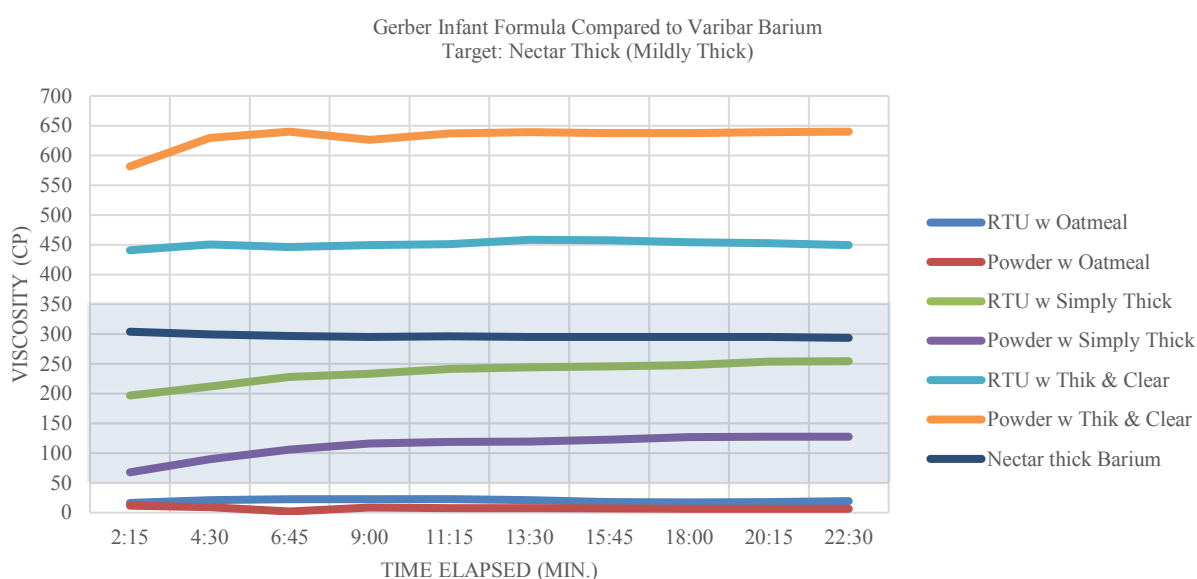


Figure 1. Gerber Infant Formula Compared to Varibar Barium

Gerber Goodstart Gentle RTU (19.4 cP) and Gerber Goodstart Gentle powder formula (6.4 cP) thickened to a nectar level using Gerber Infant Oatmeal cereal fell below the NDDL range (51-350 cP). Gerber Goodstart Gentle RTU (127.6 cP) and Gerber Goodstart Gentle powder formula

(254.4 cP) thickened with Simply Thick remained within the target range throughout the duration of testing. Both recipes increased in viscosity until eleven minutes and fifteen seconds where they remained constant throughout the duration of the test. Gerber Goodstart Gentle RTU (449.6 cP) and Gerber Goodstart Gentle powder (640cP) thickened using Thik & Clear exceeded the targeted nectar viscosity level.

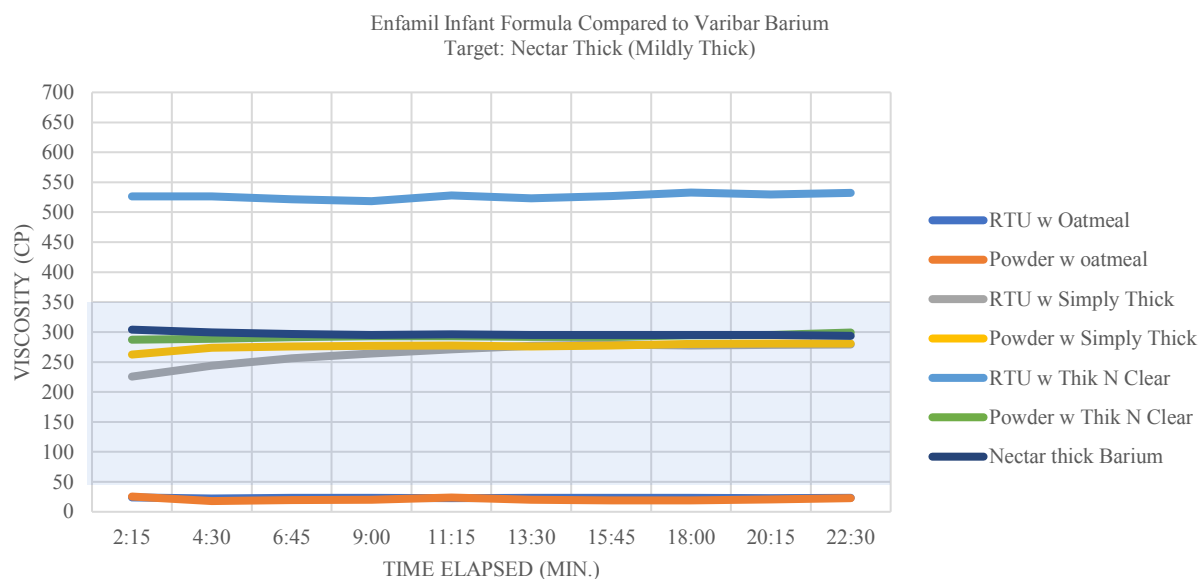


Figure 2. Enfamil Infant Formula Compared to Varibar Barium

Enfamil RTU (23.2 cP) and Enfamil powder infant formula (22.7cP) thickened to a nectar level using Gerber Infant Oatmeal cereal, falling below the NDDL range. Enfamil RTU (279.2 cP) and Enfamil powder formula (280.2) thickened with Simply Thick remained in the target range throughout the duration of the test. Similar to the Gerber brand products, both Enfamil products increased in viscosity until the 11-minute mark and then remained consistent for the remaining time. Enfamil RTU (532 cP) surpassed the targeted viscosity level while Enfamil powder formula (299.2 cP) remained in the targeted nectar level.

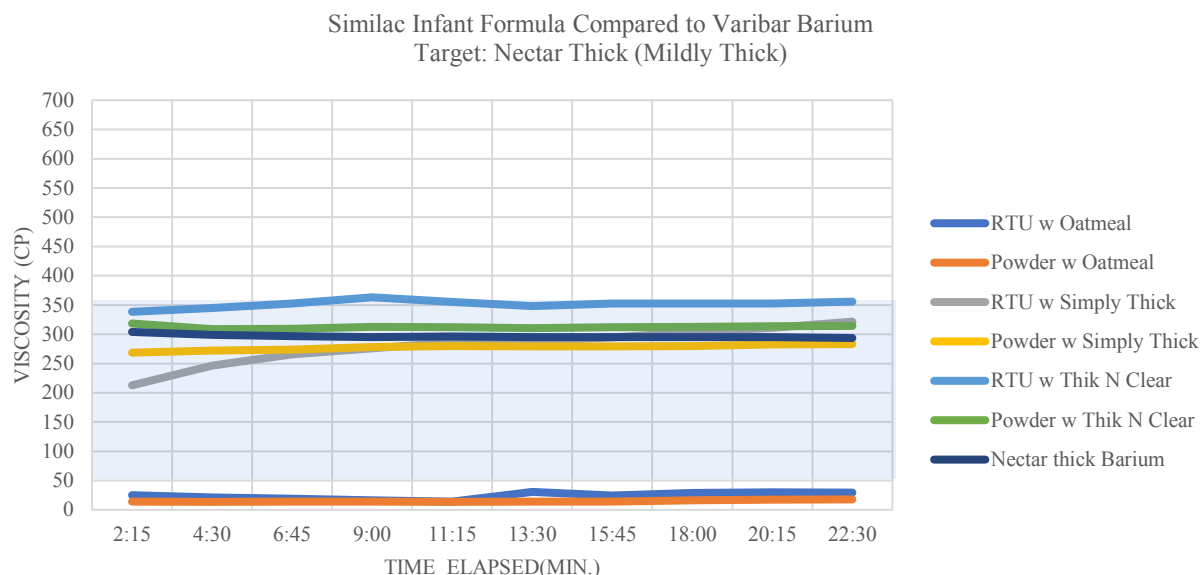


Figure 3. Similar Infant Formula Compared to Varibar Barium

Similac Advance RTU (29.6 cP) and Similac Advance powder formula (17.8 cP) thickened to the nectar level using Gerber Infant Oatmeal cereal. Similac Advance RTU (321.6 cP) and Similac Advance powder formula (283.2 cP) thickened with Simply Thick remained within the target range throughout the test period. Both recipes continued to increase in viscosity throughout the test. Similac Advance RTU (356 cP) and Similac Advance powder formula (314.4 cP) thickened with Thik & Clear remained in the target range throughout the duration of the test.

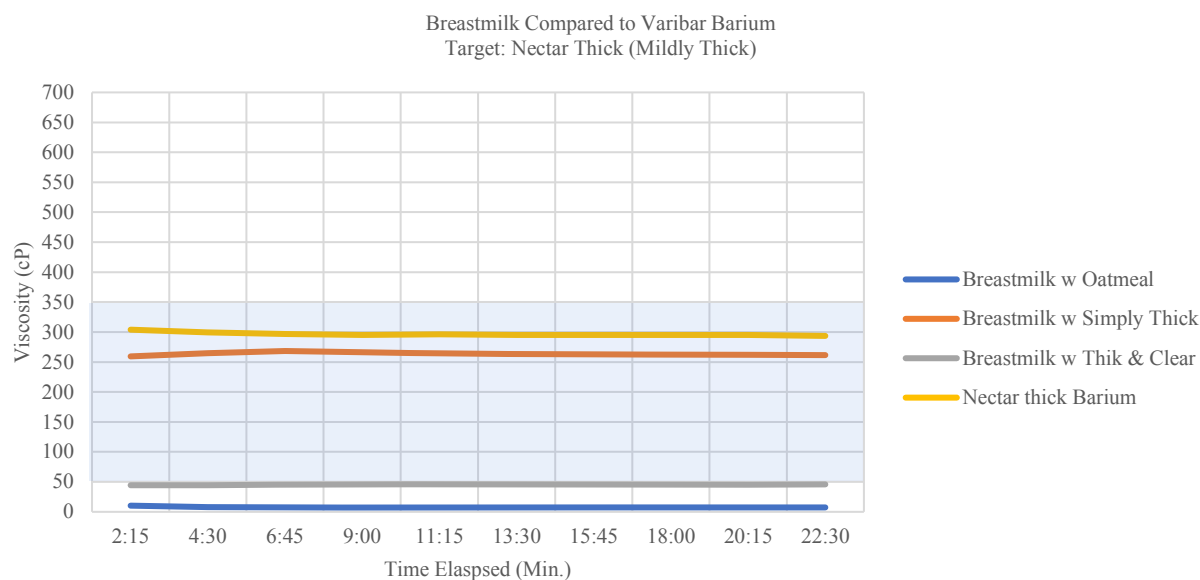


Figure 4. Breastmilk Compared to Varibar Barium

Breastmilk thickened with Gerber Infant Oatmeal cereal (7.28 cP) fell below the target NDDL range. Breastmilk thickened with Simply Thick (261.3 cP) thickened to the nectar thick level and remained constant throughout the test. Breastmilk thickened with Thik & Clear (45.6) failed to reach the targeted nectar thick level.

Liquids Tested	Gerber Infant Oatmeal		Simply Thick Level 2		Thik & Clear Nectar	
	mL Remaining	IDDSI Level	mL Remaining	IDDSI Level	mL Remaining	IDDSI Level
Gerber RTU	3.9	1	3.9	1	8.3	3
Gerber Powder	3.3	1	4	2	8.6	3
Enfamil RTU	2.1	1	5	2	8.6	3
Enfamil Powder	1	1	5.2	2	6.8	2
Similac RTU	0.1	1	2.1	1	8.1	3
Similac Powder	3.8	1	5.2	2	7	2
Breastmilk	0	0	4.9	2	3.8	1

Figure 5. IDDSI Test Results

Represented in this chart are the IDDSI levels of each liquid tested included in figures one through four. These findings show that none of the recipes utilizing Gerber Infant Oatmeal Cereal reach the desired IDDSI level. Simply Thick recipes reached the desired IDDSI level consistently with Gerber powder formula, Enfamil RTU, Enfamil powder, Similac powder and breastmilk. Simply Thick combined with Gerber RTU and Similac RTU failed to reach the desired viscosity level. Thik & Clear recipes exceeded the targeted IDDSI level in Gerber RTU, Gerber Powder, Enfamil RTU and Similar RTU. Thik & Clear reached the desired IDDSI level when combined with Enfamil Powder and Similac Powder. Thik & Clear combined with Breastmilk fell short of the desired IDDSI level.

Conclusion:

Overall, Simply Thick was the most consistent thickener tested, and the only thickening agent that consistently measured within the nectar range suggested by NDDL. Food thickening agent, Gerber Infant Oatmeal cereals, resulted in significantly lower viscosities when compared to NDDL. Separation of the thickening agent from the formula was evident and interfered with IDDSI measurement. IDDSI measurements, while much more accessible, had consistent viscometer and IDDSI levels 81% of the time. A discrepancy was noted between Nectar Varibar Barium used during instrumental evaluations and nectar thick recipes prescribed for use. These results are in line with other studies conducted to gain insight into the viscosity of liquids used in infant dysphagia treatment. Our profession lacks an understanding of the chemical and nutritional properties of infant formulas and breastmilk. (Frazier, Chestnur, Jackson, Barbon, Steele, Pickler, 2016) Further research is warranted to continue to increase the quality of care provided to clinical patients.

Recommendations:

This analysis of data collected throughout the Ball State University Immersive Learning course *Analysis of Fluid Viscosities Used to Treat Human Dysphagia* sought to find clinical application of data sets. Instead, this analysis shows further testing is warranted. Moving forward, it is critical that clinicians utilize professional relationships to pursue multidisciplinary efforts to combat inaccurate treatment of dysphagia. Further research methods could include: feeding position (Robbins, Gensler, Hind, Logeman, Lindblad, et al, 2008), the effects of heating treatment fluids (Garcia, Chamera, Matta, Clark, 2007), modified flow rate, and longitudinal studies. (Jadcherla, Stoner, Gupta, Bates, Fernandez, Di Lorenzo & Linscheid, 2009) Examples of longitudinal variables might include: growth outcomes, nutritional outcomes and hospital length of stay.

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Appendices

- 1. ISHA 2019 Poster Presentation**
- 2. Infant Formula Viscosity Data Sheet**

The Analysis of Fluid Viscosities Used to Treat Neonatal Dysphagia Patients

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ABSTRACT

The treatment of Dysphagia is hampered by the use of various liquid viscosities used during swallowing therapy. During experiments conducted in an Immersive Learning course at Ball State University, students used viscometers and the IDDSI drip test to analyze the viscosities of thickened liquids. Measurements were compared to Varibar Barium to determine the correlation with prescribed thickened liquids.

INTRODUCTION

It is known that Speech Language Pathologists in different facilities across the nation use a variety of thickening agents and recipes as therapeutic measures for infants diagnosed with dysphagia. Limited research has been completed in this area. Undergraduate and Graduate level students have participated in an Immersive Learning Course PHYC 469/685 at Ball State University to determine the viscosity levels of liquids commonly consumed by patients diagnosed with dysphagia. This interdisciplinary course that is student driven, requires students to work in small groups while communicating with the community partners to solve a problem related to the clinical world. Students gathered information from the community partners St. Vincent Health System, (Molly Jones, M.A. CCC-SLP) and Meridian Pediatric Rehabilitation, (Catherine Seitz, M.A. CCC-SLP, BCS-S) at the beginning of the course to determine possible liquids and thickeners to be tested. Thickeners tested include commonly reported food products in the pediatric population such as infant oatmeal cereal as well as commercially available thickeners used with pediatric patients diagnosed with dysphagia. Results were then compared to the viscosity of Varibar Barium, a common contrast material utilized during instrumental evaluation, in order to determine prescribed appropriate liquid level.

Viscosity was tested to determine the thickness, measured in centipoise (cP), of each thickening agent mixed with a variety of infant formulas commonly consumed. The values were then compared to Varibar Barium, the National Dysphagia Diet levels and the IDDSI levels to determine which thickening agent resulted in the desired viscosity levels. The main goal was to determine if the assumed thickness level (viscosity) of prescribed thickened liquids was actually within desired levels. This topic is of high concern because of its impact on the safety and well-being of patients with dysphagia.

METHODS

Two Brookfield DV2T Viscometers and one Brookfield DV3T Viscometer were used to collect the viscosity levels. The same sample was then measured with the IDDSI drip test. The liquids selected to present include: Gerber Gentle Ready to use (RTU), Gerber Gentle Powder formula, Enfamil Infant Ready to use (RTU) formula, Enfamil Infant Powder formula, Similac Advanced Ready to use (RTU), Similac Advanced powder formula and breastmilk. Baseline data was collected for all liquids tested prior to mixing with chosen thickener.

A standardized process for preparing infant powdered formula consisted of adding the formula to the room temperature water according to the packaged instructions and shaking for twenty seconds. The process for thickening with infant oatmeal cereal, involved mixing prepared formula as described above. The recipes utilized were 15 cubic centimeters (cc) of infant oatmeal cereal per two ounces of liquid. Each mixture was shaken for twenty seconds. The thickened liquid was poured into a beaker and tested using a Brookfield DV2T Viscometer. For Simply Thick and Thik & Clear thickeners, the sixteen ounces formula was separated into two beakers with eight ounces in each beaker to accommodate the sample size. Simply Thick and Thik & Clear tests were mixed, according to packaging with each eight ounces of liquid. Each mixture was stirred for twenty seconds then combined into one sixteen-ounce beaker. The mixture then sat for five minutes, was stirred for twenty seconds to ensure the sample was well blended and then tested using a Brookfield DV2T Viscometer.

All thickened liquids were tested using multipoint averaging of two minutes and fifteen second intervals for a total of twenty-three minutes. The data was recorded on a spreadsheet and displayed in graphs. The viscosity of Varibar Barium thin and nectar were tested using a small sample adapter and Enhanced UL Adapter on the Brookfield DV3T Viscometer as a baseline to compare the thickened liquid samples. All samples were tested after the five-minute wait time utilizing the International Dysphagia Diet Standardization Initiative (IDDSI) drip test prior to viscometer testing.

Figure 1.

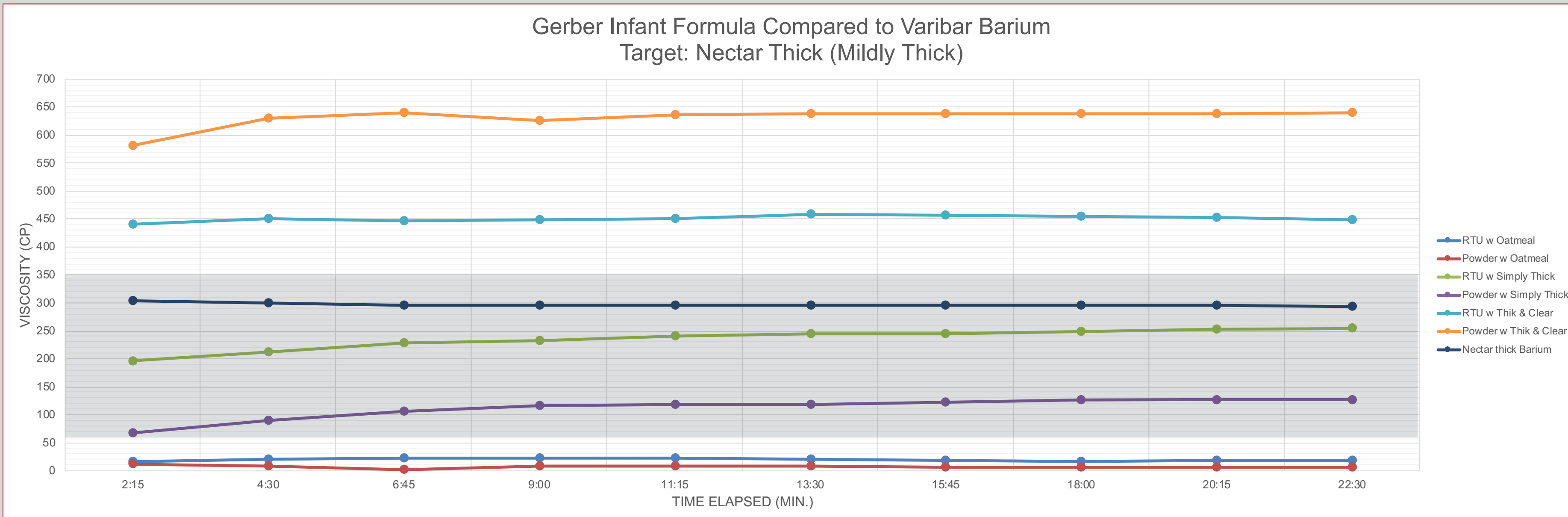


Figure 2.

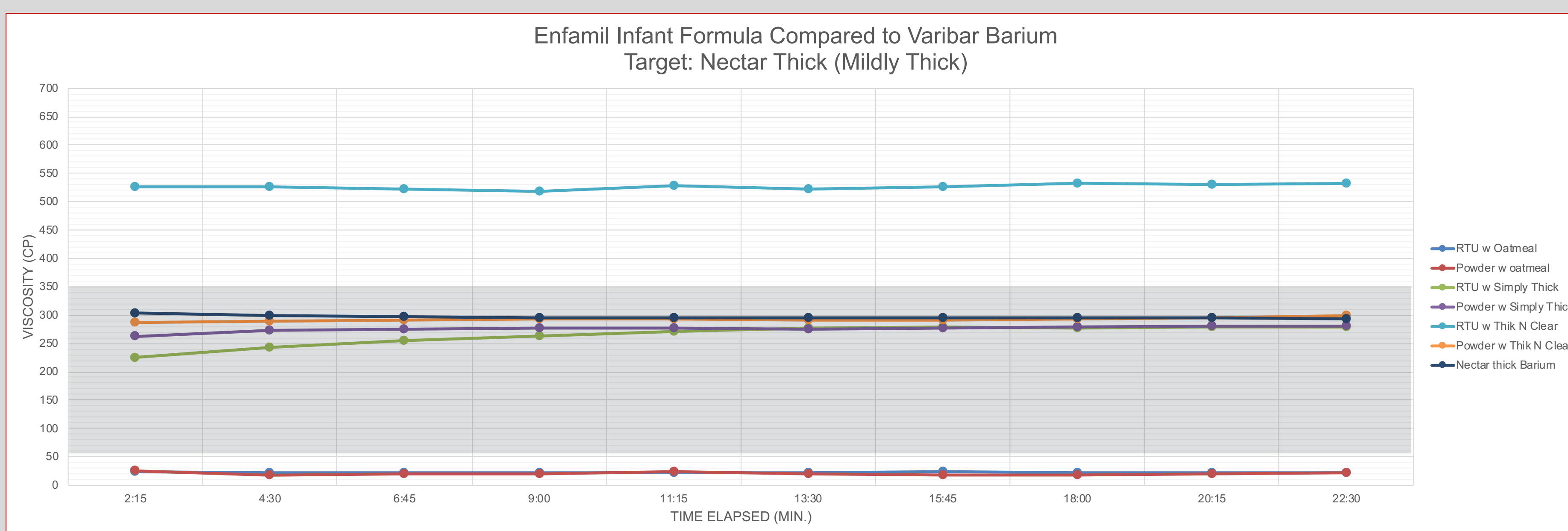


Figure 3.

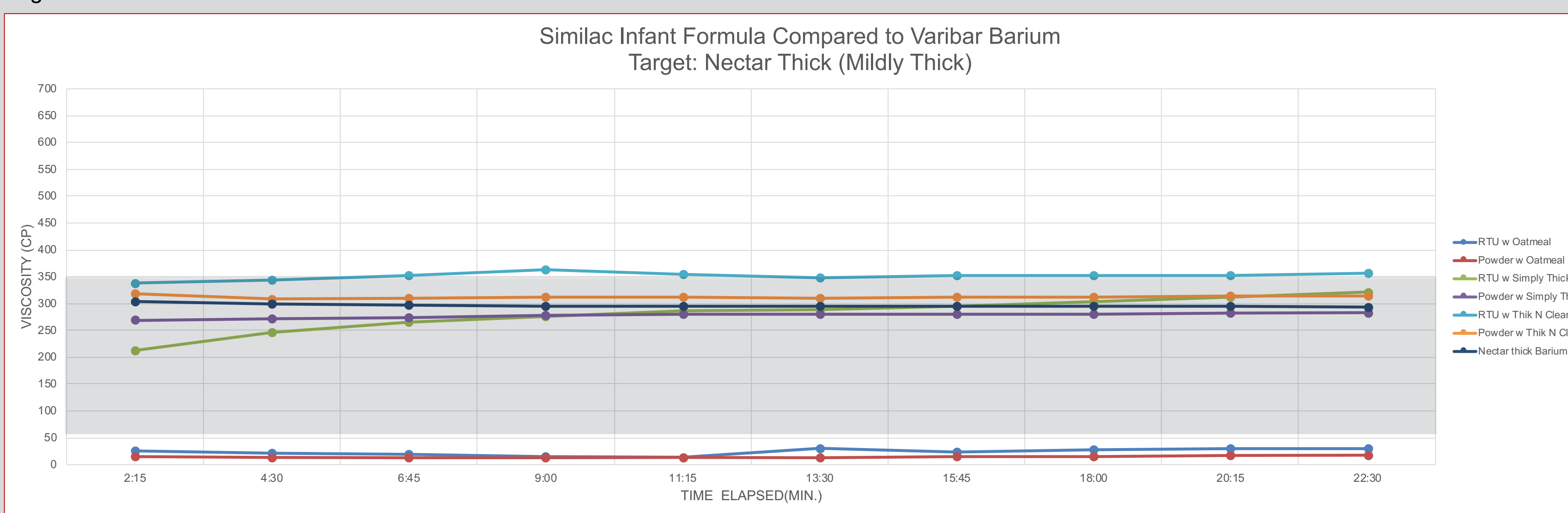


Figure 4.

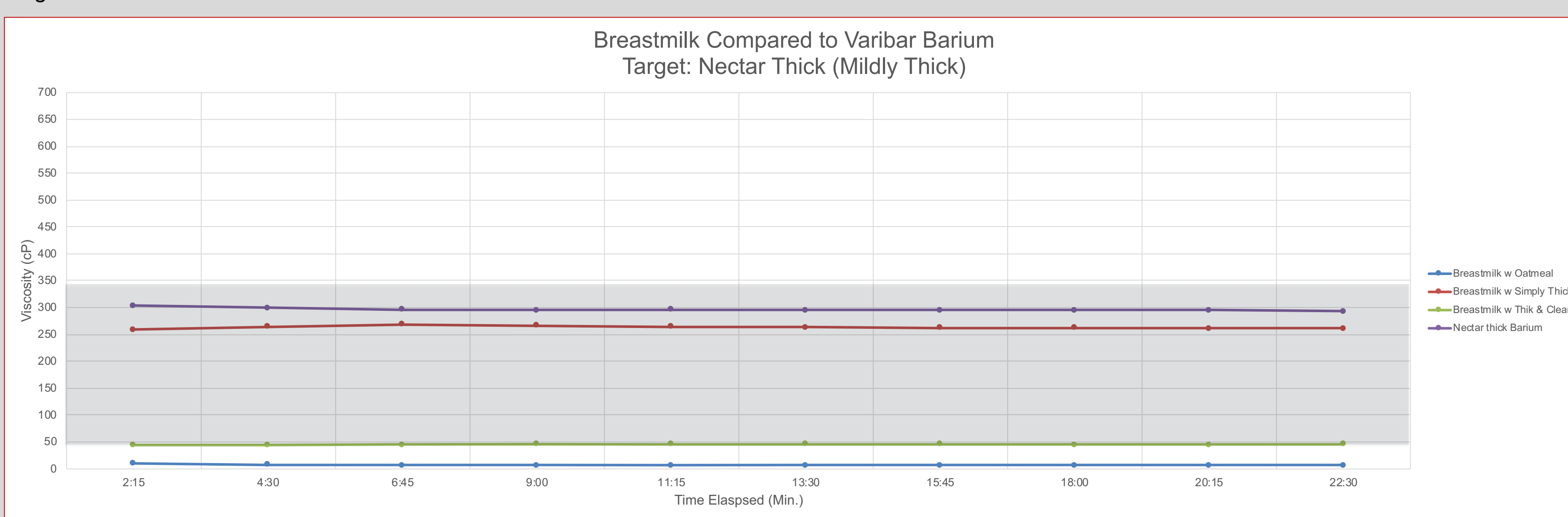


Figure 5.

Liquids Tested	Gerber Infant Oatmeal		Simply Thick Level 2		Thik & Clear Nectar	
	mL Remaining	IDDSI Level	mL Remaining	IDDSI Level	mL Remaining	IDDSI Level
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Gerber Powder	3.3	1	4	2	8.6	3
Enfamil RTU	2.1	1	5	2	8.6	3
Enfamil Powder	1	1	5.2	2	6.8	2
Similac RTU	0.1	1	2.1	1	8.1	3
Similac Powder	3.8	1	5.2	2	7	2
Breastmilk	0	0	4.9	2	3.8	1

RESULTS

Figures one through four represent viscosity levels of various formulas mixed with a variety of thickeners utilized for neonatal and infant populations for the treatment of dysphagia. The blue shaded area on each figure represents the nectar thick range (51 cP to 350 cP) according to the National Dysphagia Diet levels (NDDL). Each set of data was also compared to the International Dysphagia Diet Standardization Initiative (IDDSI) ten second flow test; with a target of 4-8 mL of the liquid tested remaining in the syringe, corresponding to a Level 2 thickness (mildly thick) as seen in figure five.

Figure 1: Gerber Goodstart Gentle RTU (19.4 cP) and Gerber Goodstart Gentle powder formula (6.4 cP) thickened to a nectar level using Gerber Infant Oatmeal cereal fell below the NDDL range (51-350 cP). Gerber Goodstart Gentle RTU (127.6 cP) and Gerber Goodstart Gentle powder formula (254.4 cP) thickened with Simply Thick remained within the target range throughout the duration of testing. Both recipes increased in viscosity until eleven minutes and fifteen seconds where they were constant throughout the remainder of the test. Gerber Goodstart Gentle RTU (449.6 cP) and Gerber Goodstart Gentle powder (640cP) thickened using Thik & Clear exceeded the targeted nectar viscosity level.

Figure 2: Enfamil RTU (23.2 cP) and Enfamil powder infant formula (22.7cP) thickened to a nectar level using Gerber Infant Oatmeal cereal, falling below the NDDL range. Enfamil RTU (279.2 cP) and Enfamil powder formula (280.2 cP) thickened with Simply Thick remained in the target range throughout the duration of the test. Similar to the Gerber brand products, both Enfamil products increased in viscosity until the 11-minute mark and then remained consistent for the remaining time. Enfamil RTU (532 cP) surpassed the targeted viscosity level while Enfamil powder formula (299.2 cP) remained in the targeted nectar level.

Figure 3: Similac Advance RTU (29.6 cP) and Similac Advance powder formula (17.8 cP) thickened to the nectar level using Gerber Infant Oatmeal cereal. Similac Advance RTU (321.6 cP) and Similac Advance powder formula (283.2 cP) thickened with Simply Thick remained within the target range throughout the test period. Both recipes continued to increase in viscosity throughout the test. Similac Advance RTU (356 cP) and Similac Advance powder formula (314.4 cP) thickened with Thik & Clear remained in the target range throughout the duration of the test.

Figure 4: Breastmilk thickened with Gerber Infant Oatmeal cereal (7.28 cP) fell below the target NDDL range. Breastmilk thickened with Simply Thick (261.3 cP) thickened to the nectar thick level and remained constant throughout the test. Breastmilk thickened with Thik & Clear (45.6) failed to reach the targeted nectar thick level.

Figure 5: Represented in this chart are the IDDSI levels of each liquid tested included in figures one through four.

CONCLUSION

Overall, Simply Thick was the most consistent thickener tested, and the only thickening agent that consistently measured within the nectar range suggested by NDDL. Food thickening agent, Gerber Infant Oatmeal cereal, resulted in significantly lower viscosities when compared to NDDL. Separation of the thickening agent from the formula was evident and interfered with IDDSI measurement. A discrepancy was noted between Nectar Varibar Barium used during instrumental evaluations and nectar thick recipes prescribed for use. However, further testing needs to be completed. The Ball State Immersive Learning project is ongoing and will continue to seek insight from other disciplines to ask and answer crucial questions.

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